REMARKS

In order to expedite the prosecution of the present application and more particularly point out and distinctly claim the subject matter which Applicants regard as the invention, Claim 1 has been amended to consist essentially of the recited ingredients. No new matter has been added.

Claims 1, 2, 5, 6, 8 and 9 have been rejected under 35 USC 103(a) as being unpatentable over Shipley, Jr. et al in view of Verbunt, Kondo et al and Yoshida et al. Claim 3 has been rejected under 35 USC 103(a) as being unpatentable over Shipley in view of Verbunt, Kondo and Yoshida and further in view of Amelio et al. Claims 1-3, 5, 7 and 8 have been rejected under 35 USC 103 as being obvious over Japan '779 in view of Verbunt, Kondo and Yoshida et al. Claims 1, 2 and 5-9 have been provisionally rejected on the ground of nonstatutory obviousness-type double patenting over Claims 1-3 of co-pending application serial number 12/075 745, alone, or in view of Shipley, Jr. et al, Verbunt, Kondo et al and Yoshida et al. Applicants respectfully traverse these grounds of rejection and urge reconsideration in light of the following comments.

The presently claimed invention is directed to an electroless copper plating solution consisting essentially of a water-soluble nitrogen-containing polymer and glyoxylic acid and phosphinic acid as reducing agents. The concentration of the water-soluble nitrogen-containing polymer is 0.0001-5 g/L, the concentration of glyoxylic acid is 0.005-0.5 mol/L and the concentration of phosphinic acid is 0.001-0.5 mol/L.

As discussed in the previous Response, the present invention is based on the discovery that the addition of a water-soluble nitrogen-containing polymer to an electroless copper plating solution containing phosphinic acid and glyoxylic acid as reducing agents results in the initial plating reactivity through the catalyst metal being higher, thereby enabling the provision of a uniform plating at lower

temperatures on a semiconductor or other mirrored-surface substrate. The present invention allows the plating deposition speed to be controlled, the crystals to become finer and the adhesion of the plating to a wafer or other mirrored-surface substrate to increase. The prior art cited by the Examiner does not disclose the presently claimed invention.

The Shipley, Jr. et al reference discloses a method of performing electroless copper deposition. This reference discloses the use of a solution comprising a polymer dispersible in an alkaline solution containing formaldehyde and a complexed cupric ion. Hydroxyalkyl substituted amines are disclosed as being complexing agents for the cupric ions. However, this reference requires formaldehyde as an essential ingredient and formaldehyde is expressly excluded from the present invention and there is no disclosure in this reference of glyoxylic acid and phosphinic acid being contained therein. Therefore, the secondary references cited by the Examiner must provide the motivation to one of ordinary skill in the art to modify Shipley, Jr. et al in a manner that would yield the presently claimed invention. It is respectfully submitted that the secondary references contain no such disclosure.

The Verbunt reference discloses a copper bath composition comprising water, copper ions, hydroxide ions, a complexing agent for inhibiting the formation of copper oxides, copper hydroxides and copper salts, a stabilizer to reduce the rate of electroless copper plating, a reducing agent to promote the electroless reduction of the copper ions to copper metal and a catalyst to promote electrolytic reduction in copper ions to copper metal. This reference discloses that a formaldehyde-free reducing agent can be used in the plating solution disclosed there and that the reducing agent is selected from the group consisting of glyoxylic acid, dimethylamine borane, hypophosphite, borohydride, hydrazine and mixtures thereof. This reference further discloses that the source of the hypophosphite can be hypophosphorus acid.

From this disclosure, the Examiner posits that it would be obvious to include combinations of glyoxylic acid and hypophosphorus acid as a reducing agent in place of the formaldehyde disclosed in Shipley, Jr. However, the Verbunt reference also requires that hydroxide ions provided by tetramethyl ammonium hydroxide, sodium hydroxide, potassium hydroxide or lithium hydroxide and the complexing agent and stabilizer disclosed there are excluded from the present invention. Additionally, this reference has no disclosure of a water-soluble nitrogen-containing polymer being present. In the Verbunt reference, the reducing agents of glyoxylic acid and phosphinic acid are required to be present with other components expressly excluded from the presently claimed invention and there is no showing in this reference that glyoxylic acid and phosphinic acid would work as a reducing agent in conjunction with a water-soluble nitrogen-containing polymer. As such, Applicants respectfully submit that the Examiner is selecting bits and pieces out of this reference and combining it with Shipley, Jr. to the total exclusion of the teachings of Verbunt as a whole.

Moreover, the Verbunt disclosure is similar to the bath composition of Comparative Example 1 of the present specification in which glyoxylic acid and phosphinic acid are used as reducing agents without the presence of the water-soluble nitrogen-containing polymer. The plating film formed using the plating bath of Comparative Example 1 was inferior and had problems such as peeling, poor adhesion and trench portions of the film were not fully embedded. As such, Verbunt in combination with Shipley, Jr. clearly does not disclose the presently claimed invention and the remaining references cited by the Examiner must provide the motivation to one of ordinary skill in the art to modify these references in a manner to yield the presently claimed invention.

The Kondo et al reference discloses an electroless copper plating solution comprising a trialkanolmonoamine as a complexing agent for copper ion and as an accelerator, a

reducing agent and a pH-adjustor. This reference further discloses that the reducing agent is not particularly limited and formaldehyde and derivatives and precursors thereof are most suitable. This reference has been cited by the Examiner as disclosing that hypophosphite can be used with formalin as reducing agents and that the inclusion of hypophosphite allows a reduction in the amount of formalin used and an acceleration of plating reaction when used with triethylamine-containing baths. However, the Kondo et al reference specifically states that sodium hypophosphite alone does not cause a reaction but appears as a reducing agent if formaldehyde coexists. This teaches away from the presently claimed invention in which formaldehyde is not present and is not properly combinable with the Verbunt reference since Verbunt is also expressly directed to a formaldehyde-free plating solution. As such, the Kondo reference in fact supports the unobviousness of the presently claimed invention as it teaches away from the use of hypophosphite as a reducing agent unless formaldehyde is present.

The Yoshida et al reference is directed to an electroless copper plating bath containing a cupric compound, a cupric ion complexing agent, a reducing agent and a pH adjusting agent and additionally requires a carboxylic acid as a reaction accelerator to accelerate the oxidation reaction of the reducing agent. Formaldehyde is not required as a reducing agent in the electroless copper plating bath of this reference. Yoshida et al has no disclosure of a phosphite being present and additionally requires the presence of a carboxylic acid in combination with the glyoxylic acid as a reaction accelerator. The presently claimed invention excludes a carboxylic acid from being contained in the plating solution and requires the presence of phosphinic acid which is not shown by this reference. As such, Yoshida et al in combination with Kondo et al, Verbunt and Shipley, Jr. et al do not even present a showing of prima facie obviousness under 35 USC 103(a).

As explained previously, the Examiner cannot select bits and pieces out of individual references and combine them to the total exclusion of the disclosures of the references as a whole which teach away from the combination urged by the Examiner. Hindsight provided by the present specification has provided the motivation for the Examiner to combine the references in the manner done here and is clearly improper.

The Amelio et al reference discloses an electroless copper plating bath which has improved stability and contains a cationic polymer from acrylamide and/or methacrylamide and also contains a cupric ion source, a reducing agent and a complexing agent. This reference has been cited by the Examiner as disclosing the water-soluble nitrogen-containing polymer of the present invention being used in an electroless copper plating bath and that these polymers can have a relatively high molecular weight of about 50,000 to 1 million or more. However, this reference does not cure the deficiencies of the previously cited reference and, as such, Amelio et al, in combination with the previously discussed references, does not even present a showing of prima facie obviousness under 35 USC 103(a).

Japan '779 discloses an electroless copper plating bath consisting of a copper oxide, a reducing agent and a complexing agent consisting of polyethylene amine. This reference, as admitted by the Examiner, does not disclose a reducing agent being made of both glyoxylic acid and phosphinic acid, the precise molecular weight and Mw/Mn ratio, the actual plating and the concentration of the polymer used. The secondary references discussed above have been cited by the Examiner as providing the motivation to one of ordinary skill in the art to modify Japan '779 in a manner that would yield the presently claimed invention. It is respectfully submitted that the secondary references contain no such disclosures.

As discussed previously, although Verbunt does disclose that the reducing agent can comprise glyoxylic acid and a

hypophosphite, this reference does not disclose the presence of a water-soluble nitrogen-containing polymer or suggest that the reducing agent disclosed there would be effective in a copper electroless plating solution which does contain a water-soluble nitrogen-containing polymer. The Kondo reference requires that formaldehyde be present in addition to a hypophosphite. This clearly teaches away from the present invention in which formaldehyde is expressly excluded therefrom. Yoshida et al requires a carboxylic acid accelerator to be present in an electroless copper plating bath which does not contain formaldehyde and uses glyoxylic acid as a reducing agent. The carboxylic acid accelerator of Yoshida et al is expressly excluded from the present invention. Therefore, the rejection based on Japan '779 in combination with Verbunt, Kondo et al and Yoshida et al suffers from the same defects as the previously discussed rejection under 35 USC 103(a). The references simply are not properly combinable in the manner suggested by the Examiner and, as such, do not present a showing of prima facie obviousness under 35 USC 103(a).

With respect to the provisional obviousness-type double patenting rejection over Claims 1-3 of application Serial No. 12/075 745, alone, or in view of Shipley, Jr. et al, Verbunt, Kondo et al and Yoshida et al, Claims 1-3 of application Serial No. 12/075 745 disclose an electroless plating solution containing a water-soluble nitrogen-containing polymer and glyoxylic acid and phosphinic acid as a reducing agent. However, the claims of this application have no disclosure with respect to the concentration of the water-soluble nitrogen-containing polymer, the glyoxylic acid and the phosphinic acid. As discussed in the present specification, the effects of the present invention would not be achieved if the concentration of the water-soluble nitrogen-containing polymer is below 0.0001 g/L and the plating reaction would be overly inhibited and deposition would no longer occur if a concentration of 5 g/L was exceeded. With respect to the

glyoxylic acid, a plating reaction would not occur if the concentration thereof was less than 0.005 m/L and the plating solution would be unstable and decompose if a concentration of 0.5 m/L was exceeded. If the concentration of phosphinic acid was less than 0.001 m/L, a plating effect would not be seen and the plating solution would become unstable and decompose if a concentration of over 0.5 m/L was exceeded. This is clearly unexpected in light of the disclosure of Claims 1-3 of application Serial No. 12/075 745 and, as such, the presently claimed invention is patentably distinguishable thereover. With respect to the secondary references, as discussed above, they teach away from being combined with the claims of Serial No. 12/075 745 and actually further support the patentability of the presently claimed invention.

The Examiner is respectfully requested to reconsider the present application and to pass it to issue.

Respectfully submitted,

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